United States Patent [19]
Matsuda et al.
[11] 3,852,735
[45] Dec. 3, 1974

[54] ALARM APPARATUS UTILIZING HIGH FREQUENCY

[75] Inventors: Shigeo Matsuda; Nasoshi Obara, both of Tokyo, Japan

[73] Assignee: Modern Electronic Instrument Corporation, Tokyo, Japan

[22] Filed: Mar. 2, 1972

[21] Appl. No.: 231,214

[30] Foreign Application Priority Data

Aug. 9, 1971 Japan 46-71230

[52] U.S. Cl. .... 340/258 C, 340/221, 340/258 A, 340/276, 340/309.1

[51] Int. Cl. G08b 13/26

[58] Field of Search ..... 340/221, 258 C, 276, 258 A

[56] References Cited

UNITED STATES PATENTS

2,767,393	10/1956	Bagno	340/258 A
2,826,753	3/1958	Chapin	340/258 C
2,979,706	4/1961	Simon et al.	340/258 C X
3,129,415	4/1964	McKnight	340/258 C
3,483,437	12/1969	Coyne	340/258 C
3,634,846	1/1972	Fogiel	340/221 X
3,644,918	2/1972	Perlman	340/276
3,673,590	6/1972	Corvi et al.	340/258 A
3,706,961	12/1972	Sugiura	340/258 A
3,727,216	4/1973	Antonio	340/258 A
3,728,721	4/1973	Lee et al.	340/258 A

Primary Examiner—David L. Trafton
Attorney, Agent, or Firm—Weiner, Basile and Weintraub

[57] ABSTRACT

An alarm system utilizing electromagnetic waves for detecting a moving object comprising an antenna and a transmitter-reciever apparatus having an oscillation loop for detecting changes in the impedance of the antenna. An amplifier circuit amplifies an output signal from the transmitter-receiver apparatus, and an alarm device operatively connected to the amplifier circuit is operated by the amplified signal so that an alarm is produced in response to an object moving in the range of space covered by the electromagnetic waves radiated from the antenna. A plurality of video cameras may also be operatively connected to a plurality of such transmitter-receiver apparatus.

7 Claims, 6 Drawing Figures

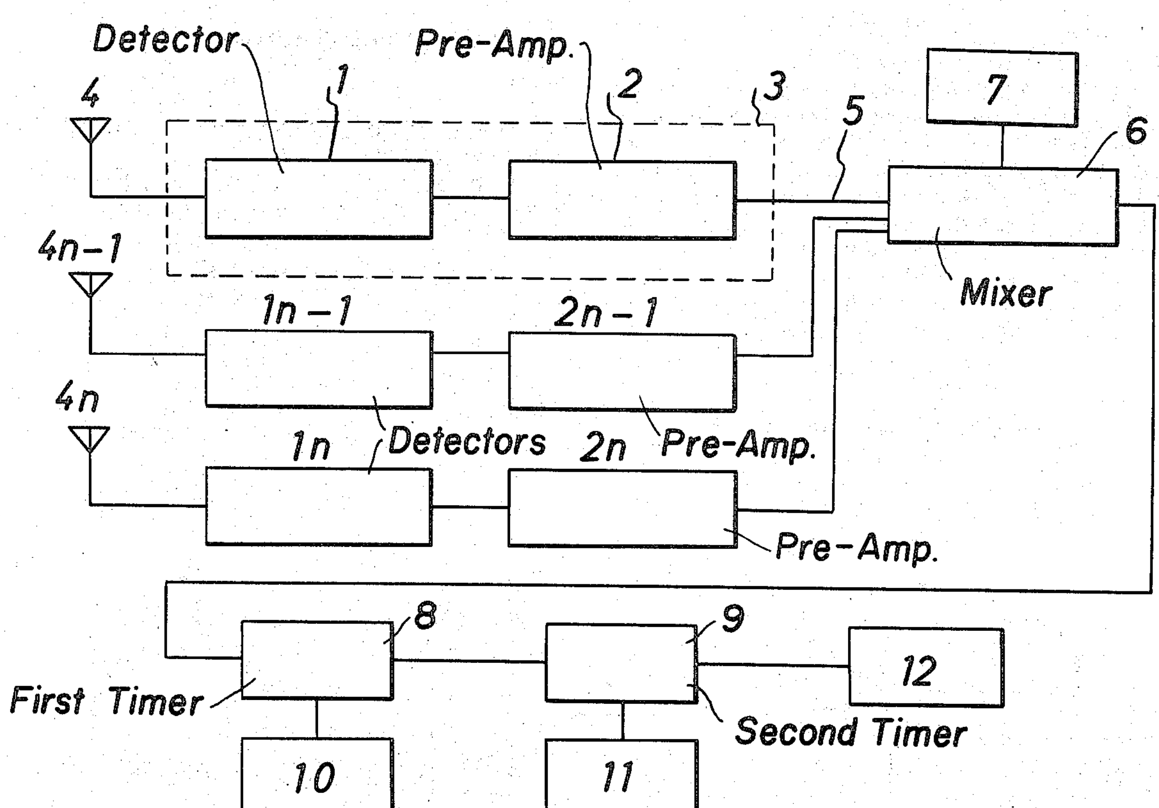


FIG. 1

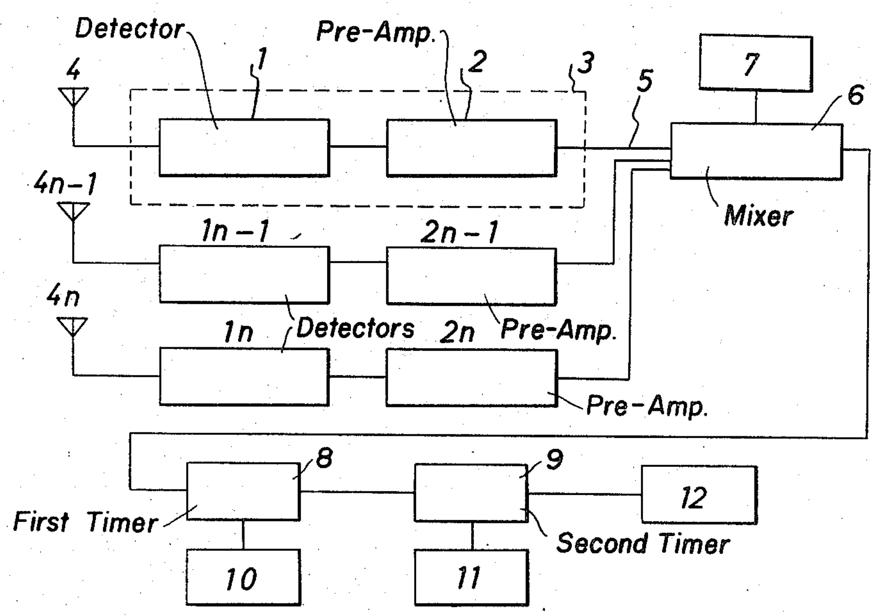

Detector
Pre-Amp.
1
2
3
4
5
6
7
4n-1
1n-1
2n-1
Mixer
4n
1n
Detectors
2n
Pre-Amp.
Pre-Amp.
8
9
First Timer
12
Second Timer
10
11

FIG. 2

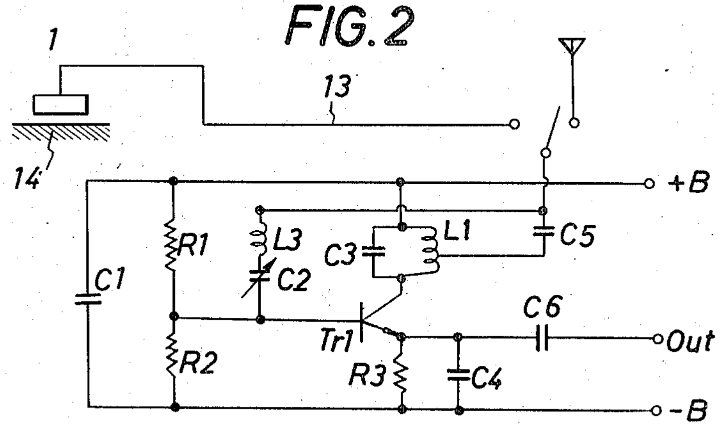

1
13
14
+B
R1
L3
C2
C3
L1
C5
C1
C6
Tr1
Out
R2
R3
C4
-B

FIG.3

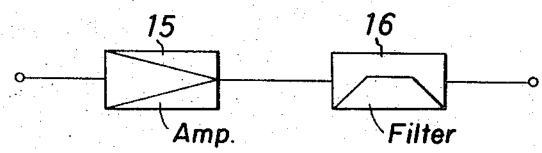

15
16
Amp.
Filter

FIG.4

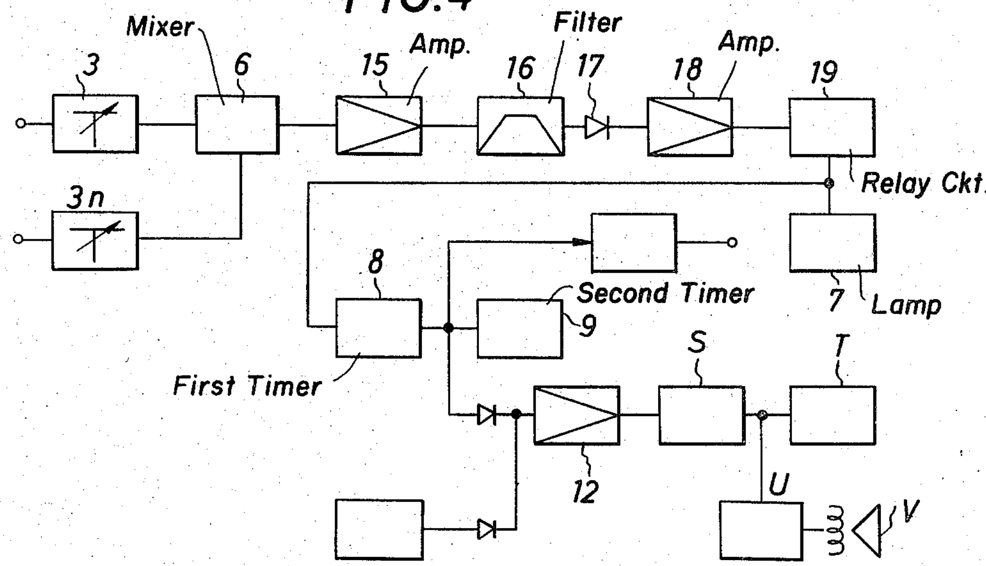

Mixer
3
6
15
Amp.
16
Filter
17
18
Amp.
19
Relay Ckt.
3n
8
Second Timer
9
7
Lamp
First Timer
S
T
12
U
V

FIG. 5

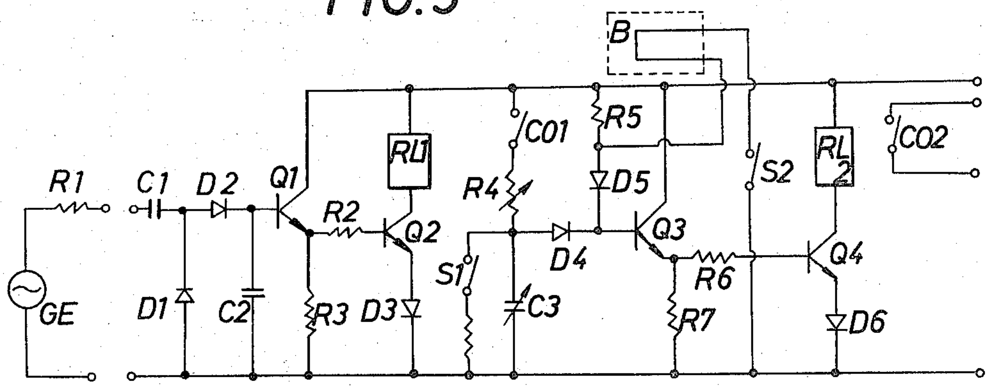
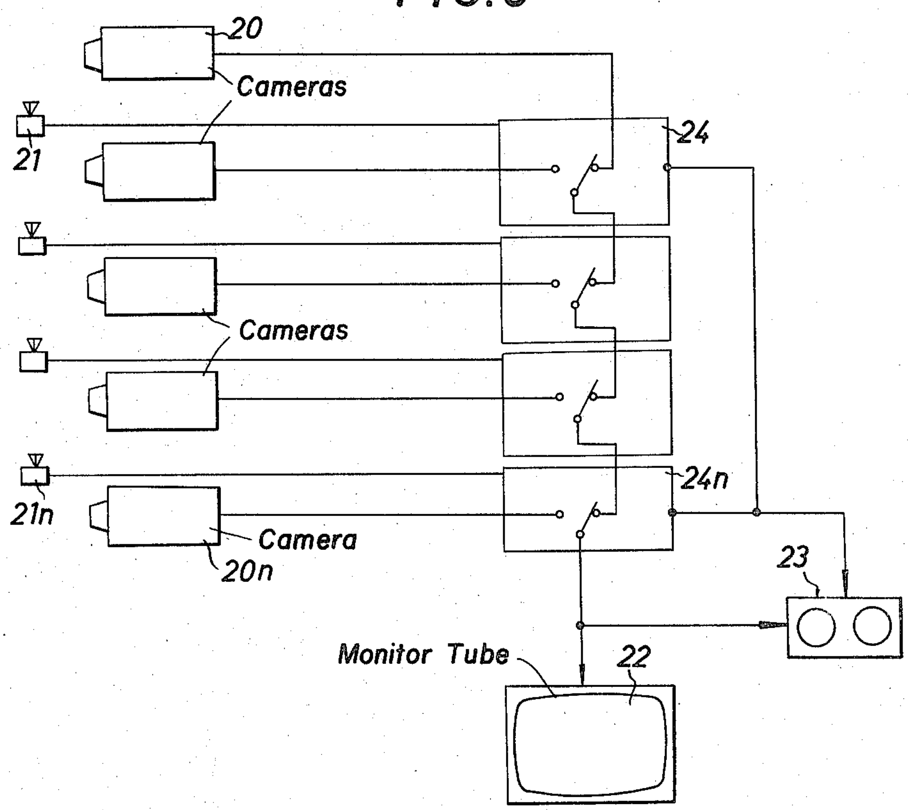

B
R1
C1
D2
Q1
R2
Q2
RL1
C01
R4
R5
D5
Q3
S2
RL2
C02
Q4
GE
D1
C2
R3
D3
S1
D4
C3
R6
R7
D6

FIG. 6


20
Cameras
21
24
Cameras
21n
24n
Camera
20n
23
Monitor Tube
22

ALARM APPARATUS UTILIZING HIGH FREQUENCY

The present invention relates to an alarm system utilizing electromagnetic waves for detecting a moving object. In particular, the present invention relates to a system and an apparatus and its accessory devices utilizing electromagnetic waves, preferably of the UHF frequency band, for detecting a moving object.

BACKGROUND OF THE INVENTION

There are known various prior art systems utilizing electromagnetic waves for detecting a moving object. In the prior art aystem, however, the sensitivity is poor, and the operation is unstable which often results in misoperation. After all, conventional systems are frequently ill-suited for practical applications.

Solving the prior art problems, an object of this invention is to solve the problems which exist in the prior art and so provide an operably stable, highly practical apparatus for detecting a moving object.

SUMMARY OF THE INVENTION

The present invention provides an alarm system utilizing electromagnetic waves for detecting a moving object. The alarm system whereby at least one antenna means, and at least one transmitter-receiver apparatus having an oscillation loop for detecting changes in the impedance of said antenna means. An amplifier circuit is operatively connected to the transmitter-receiver apparatus for amplifying an output signal from the transmitter-receiver apparatus. An alarm device operatively connected to the amplifier circuit is operated by the amplified signal so that an alarm is produced in response to the object moving in the range of space covered by the electromagnetic waves radiated from the antenna means.

The present invention also provides an alarm system including a plurality of transmitter-receiver apparatus centrally connected to the amplifier circuit, and wherein the alarm device is operated when the antenna impedance is changed in any one of the transmitter-receiver apparatus. One embodiment of the invention also contemplates a plurality of video cameras which are operatively connected to and respectively associated with predetermined ones of said plurality of transmitter-receiver apparatus, such that an object moving in the space covered by each transmitter-receiver apparatus is monitored and/or recorded by individual monitors and/or video tape recorders operatively connected to the video cameras.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates in block form a first embodiment of the alarm system according to the principles of the present invention.

FIG. 2 is a schematic circuit diagram showing the detector and oscillator portion of the alarm system according to an embodiment of the present invention.

FIG. 3 depicts a block diagram showing the amplifier and bandpass filter comprising the preamplifier portion of the antenna circuit.

FIG. 4 is a block diagram illustrating the mixer circuit according to an embodiment of the present invention.

FIG. 5 is a schematic circuit diagram showing the details of the timing circuit according to the principles of the present invention.

FIG. 6 illustrates another embodiment of the present invention which utilizes video cameras and related monitoring and recording circuits.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, there is shown in block form an apparatus according to a first embodiment of the invention wherein the reference numeral **1** denotes a detector comprising an oscillator circuit of the UHF band wave, and a receiver circuit, for detecting a moving object. The numeral **2** indicates a preamplifier for removing the influence of noise introduced into the line connected to the apparatus. The detector **1** and the preamplifier **2** are housed in a case **3**. The numeral **4** represents an antenna, and **5** a lead wire for the oscillator, the preamplifier **2** and the main unit. This lead wire **5** can be extended as long as several hundred meters when required. The numeral **6** denotes a mixer circuit for providing an alarm output from an n-number of outputs supplied from the detectors **1**, **1**n–**1**, **1**n via antennas **4**, **4**n–**1**, **4**n.

In the alarm apparatus of this invention, one or more antennas may be used. Sensitivity adjustment is made in the mixer circuit **6** with respect to the signal from the antenna. In FIG. 1, the reference **7** denotes a protector for the alarm apparatus of this invention, which warns of abnormal states such as disconnection of the lead wire **5**, disconnection of the key cord, and opening of the door of the operator panel of the apparatus. The numeral **8** denotes a circuit comprising a first timing circuit and an alarm generator circuit. This circuit **8** is designed so as not to respond to such an incidental output as might be caused by a bird flying near the antenna **4**. The time constant of the charging circuit of the first timing circuit is determined so that the second timing circuit **9** is not operated unless more than five detection outputs are given in succession. While the first timing circuit is charged by the output sensed at the antenna **4**, the charged result can be taken out as an output of the first alarm. Therefore, if necessary, a feedback circuit **10** for lamp illumination or for alarm may be installed in the neighborhood of the antennas **1** and **2**.

The purpose of the second timing circuit **9** is to generate the second alarm for about 20 to 40 seconds when more than five detection outputs are received in succession from the antenna. When a siren or buzzer is connected to the output side of an alarm circuit **11**, an abnormal state can be broadcast over a widely spread area. The numeral **12** denotes an alarm transmission circuit for transmitting through a wire the alarm signal generated in the second timing circuit.

FIG. 2 is a schematic circuit diagram showing the oscillator part of the apparatus of this invention. This oscillator generates a high frequency signal to be radiated as a nondirective electromagnetic wave from the antenna rod for the purpose of detecting an object moving or entering in the space of the electromagnetic wave. The oscillator is provided with more than one lead wire of suitable length, through which the oscillation current of the oscillator flows thus forming an electrostatic electric field around the lead wire. Immediately, when an object comes in the electric field, the object is detected by the alarm apparatus.

The detector **1** will be described in detail by referring to FIG. **2.** A lead wire **13** is switchably connected to the oscillator circuit of the detector **1.** This lead wire **13** is disposed in a suitable position on the floor **14.** The lead wire **13** may be installed under a mat or carpet on the floor **14.** When the oscillation current flows through the lead wire **13** from the detector **1,** an electrostatic electric field is produced around the lead wire **13.** When an object comes into the pattern of the electric field, the pattern is changed (Doppler effect), and this change is taken out as an alarm or display on the alarm apparatus.

More specifically, the signal voltage, such as thermal noise, applied to the base of the transistor Tr_1 comes out at the collector as a signal component whose phase is 180° different from that of the applied signal because of the amplifying function of the transistor Tr_1. A resonant circuit comprising a capacitor C_3 and coil L_1 is connected as a load to the transistor Tr_1. In the vicinity of the resonant frequency of the resonant circuit **L1, C3,** a phase difference is produced between the amplified signal component of the collector current and the voltage generated at the collector. The capacitance component of the capacitor C_5, whose capacitance is substantially greater than that of the capacitor C_3, the inductance component of the lead terminal, and the phase difference component of the coil L_3 and capacitor C_2 are fed back all together to the base of Tr_1. The resultant signal voltage component is larger than the signal voltage, such as thermal noise, applied first to the base of the transistor Tr_1, and has a frequency standing at a phase 360° different from that of the signal applied to the base of Tr_1, i.e., the two signals become in-phase. In other words, this circuit satisfies the Nyquist oscillation condition, or sustains oscillation. The resultant oscillation output is led to the antenna through the capacitor C_5 from about the center point of the coil L_1. (Note: The center point may be adjusted to match the antenna impedance.) By this operation, the maximum energy can be radiated as an electromagnetic wave from the antenna. This oscillator is oscillated at a high frequency of the UHF band, i.e., about 400MHz, for detecting a moving object.

In FIG. **2,** the reference numeral C_1 in the oscillator circuit denotes a high frequency bypass capacitor which serves to lower the power source impedance of the oscillator circuit and stabilize the oscillation. The capacitor C_2, connected in series with the feedback circuit, serves to adjust the magnitude and phase of the feedback signal, thus adjusting the intensity of the oscillation. In order to take out effectively the antenna impedance change as an output signal component, an antenna terminal is added to the loop of the oscillator circuit. At this antenna terminal, the antenna impedance change due to the external moving object becomes present most conspicuously in terms of voltage change. when this voltage is fed back to the base of the transistor Tr_1, the antenna impedance change can be derived as a large change in the loop gain. In other words, a large output signal can be obtained as a result of change in the rectifying function (or detecting function) of the transistor Tr_1. The purpose of the capacitor C_3 is to effect a resonance in parallel with the coil L_1 and to adjust the oscillation frequency of the oscillator circuit. The capacitor C_4 is used to ground the emitter of Tr_1 by bypassing high frequency components and to prevent feedback of current to transistor Tr_1, thus increasing the degree of amplification. The capacitor C_4 serves also to remove the high frequency component introduced into the low frequency output signal from the emitter of the transistor Tr_1. The resistor R_3 is connected to the emitter of the transistor Tr_1 and serves as a DC load for controlling the current flowing between the collector and emitter of Tr_1. The resistor R_3 is the emitter resistor for self-biasing the transistor Tr_1. When there is a change in the load impedance of the antenna of the oscillator, the current flowing in this transistor Tr_1 is changed. The product of the value of this current and the value of the resistor R_3 is given as a low frequency output voltage to the output terminal via the capacitor C_6. The purpose of the capacitors C_5 and C_2 is to stop the DC component when the oscillation output is led to the antenna, thus supplying only the high frequency component to the antenna, and to prevent the apparatus from being damaged due to overcurrent which may occur by short-circuiting the antenna from a DC standpoint.

Fundamentally, this oscillator circuit is oscillated continuously based on the foregoing operating principle. Because the collector of the transistor Tr_1 of the oscillator is connected to the antenna via the capacitor C_5, the oscillation energy of high frequency current is supplied to the lead wire, which is connected to the oscillator circuit, whereby an electrostatic electric field is formed around the lead wire.

When no entering object is present in the range covered by the pattern of the electric field around the lead wire, the oscillator maintains stable oscillation with a constant amplitude. Under this condition, the oscillation current flowing in the transistor Tr_1 is constant, the voltage across the the resistor R_3 is constant, and no output signal comes out at the output terminal. However, if an object which reflects the electromagnetic wave such as an electroconductive object other than the perfect black body, is present in the range covered by the electromagnetic wave radiated from the antenna, and such object is moving, the following change is brought about in the oscillator.

Assume that the moving object is in the position distant from the origin (the position of the antenna) by an integer multiple of ¼λ of the oscillation frequency of the oscillator. This position of the object corresponds to the knot of the electromagnetic wave. Hence, the energy of the electromagnetic wave reflected from that position toward the antenna is small. It can be considered that the impedance seen from the antenna is not appreciably changed even if such moving object is present. While, the position of the object ± ⅛λ distant from said position of integer multiple of ¼λ corresponds to the swell part of the reflected wave where the amplitudes of both the E-wave and H-wave are miximum, and the energy of the electromagnetic wave reflected from the object toward the antenna becomes maximum. As a result, a leading current or lagging current component with respect to the oscillation voltage is produced according to whether the vector of the reflected wave is positive or negative with respect to the electrical vector of the antenna of the oscillator. Thereby the antenna impedance is changed capacitively or inductively. Such change in the antenna impedance is equivalent to a change which might be produced by connecting a capacitor or a coil in parallel with the capacitor C_3 of coil L_1. Therefore, the oscillation frequency is changed. As described, the oscillator is oscillated at a frequency above 400MHz, and the oscillator circuit is oscillated near the highest possible frequency. Hence, the frequency characteristic of the oscillation loop is low in the high frequency band. When the oscillation frequency in the circuit is lowered, the oscillation intensity is changed and also the antenna impedance is changed. As a result, the oscillation intensity is changed. When the oscillation voltage is large, the positive half-wave current flowing between the base and emitter of the transistor Tr_1 is increased. The collector current of transistor Tr_1 is increased B times by the rectifying function of this transistor, and the voltage across the resistor R_3 is increased. More specifically, when an object, such as a man, which is reflecting the electromagnetic wave, approaches the oscillator which has an antenna at a velocity V, an output signal ($F=Vx\ 2f_1/C$) is produced across the resistor R_3 of the oscillator due to the current variation at transistor Tr_1. [Note: V represents the approaching speed (m/sec) of the wave-reflecting object; f_1 the oscillation frequency (Hz/sec) of the oscillator; and C the electromagnetic wave propagation velocity (m/sec)] For example, when a man approaches the antenna at 75cm/sec, an output signal of 2Hz is produced at the output terminal of the oscillator circuit. (Note: The wavelength of 400MHz is 75cm.)

As has been described above, the oscillator, being a part of the apparatus for detecting a moving object by the use of electromagnetic waves, is oscillated and depends on only one transistor of a high operating sensitivity. Therefore, the number of succeeding amplifier stages can be minimized, and the operation can be stabilized for a long period of time owing to the use of a transistor. These features greatly enhance the usefulness of this invention.

Furthermore, an entering object can be securely detected by utilizing a lead wire in place of antenna. The lead wire can be installed in the space, under the mat, etc., to permit use of the apparatus in various ways.

FIG. 3 is a block diagram showing the preamplifier 2 used in the antenna circuit. The detection output of the oscillator (FIG. 2) is supplied to this preamplifier 2. As described, this output signal includes various noise components of several millivolts low frequency (about 0.1 to 10Hz). In order to obtain the necessary signal component by removing the noise components, the preamplifier 2 consists of an amplifier 15 and a bandpass filter 16, as shown in FIG. 3. The amplified output signal (about 0.1 to 1V) is delivered to its output terminal. Because the preamplifier 2 is housed with the detector 1 (FIG. 1) in one case 3, there are less possibilities of allowing entrance of external noise into the preamplifier 2. The signal, once amplified, is less affected by external noise even if the lead wire 5 connecting the preamplifier 2 to the main unit is extended. Thus, the detected signal can be supplied to the main unit at a large S/N ratio. The detection signal is then led to the mixer circuit 6 (FIG. 1).

FIG. 4 schematically illustrates the mixer circuit 6. The signals from the detector cases 3 through 3n are supplied to the antennas. These signals are adjusted by the resistance attenuator so as to determine the operating range of the detectors. The signals are electrically mixed in the mixer 6, and then voltage-amplified by the amplifier 15. The amplified output is applied to the filter 16 which passes only very low frequency components (0.1 to 10Hz) whereby the noise component, such as hum, is removed and only the detection output is obtained. This output is detected by the detector 17 whereby a DC detection output signal is obtained. The resultant output can be taken out as a DC signal proportional to the AC signal detected by the oscillator part. The numeral 18 denotes a DC power amplifier circuit for amplifying the output of said detector 17 so as to operate a relay circuit 19. When the relay circuit 19 is operated, a power source is connected to illuminate the lamp 7. Illumination of the lamp 7 shows that the oscillator part (FIG. 2) is detecting a moving object. One circuit of the relay circuit 19 is connected to the first timing circuit 8. The second timing circuit 9 is operated depending on how many times the relay circuit 19 has been operated. Normally, the first timing circuit 8 is adjusted so that the second timing circuit 9 is operated when the relay circuit 19 is operated about 5 times in succession. In other words, the second timing circuit 9 is not actuated upon one or two operations of the relay circuit 19. This consideration minimizes misoperation of the apparatus.

FIG. 5 schematically illustrates the timing circuit of this invention. As described, the detected output of the alarm apparatus is supplied to the timing circuits 8 and 9 (FIGS. 1 and 4) as an electrical AC signal in the frequency band between 0.1 and 10Hz. When the electric pulse given to the input terminal has a short period, such as an external noise, this signal cannot make the transistors Q_1 and Q_2 conducting because of the integration effect of R_1 and C_2, but the charge stored across the capacitor C_2 is discharged through the base input resistor of Q_3.

When the electric signal given to the input terminal is due to the moving object and is large in both the amplitude and the hold time, the time constants of C_2 and R_1 may be determined so that the transistors Q_1 and Q_2 are made conducting for about 0.5 second against one electrical input pulse. During this period, the relay, RL1 is operated and the relay contact CO_1 is kept conducting. When a lamp, buzzer, chime, or the like is connected to the relay contact CO_1, the presence of a moving object can be perceived visually or audibly. When the contact signal is connected directly to a large siren, such contact signal is too short (about 0.5 second) to effectively operate the siren because the operation start-up of a large siren is considerably slow. To operate a large siren effectively, it is necessary to add a second timing circuit 9 (FIGS. 1 and 4) to the relay circuit. The pulse given to the input terminal (FIG. 5) forms a contact signal of about 0.5 second per pulse by the contact CO_1. This contact signal serves to charge the capacitor C_3 by way of the resistor R_4. When more than five pulses are applied to the relay contact CO_1 in succession, the charge stored in the capacitor C_3 is increased, the voltage across the capacitor C_3 is raised, current starts to flow in the base of the transistor Q_3 via the diode D_4, the transistors Q_3 and Q_4 become conducting, the relay RL_2 is operated to make the contact CO_2 conducting, and thus the buzzer or siren can be effectively actuated.

The time constants of the resistor R_4 and capacitor C_3 are determined so that the transistors Q_3 and Q_4 are turned ON only when the capacitor C_3 is charged continuously for more than 5 seconds. Therefore, no alarm is produced unless the number of pulses forming said contact signal is more than four (namely, the signal duration is longer than about 5 seconds). At the moment the transistors Q_3 and Q_4 are turned ON, the charge stored in the capacitor C_3 is discharged through the base input resistor of the transistor Q_3. If the capacitor C_3 is not charged any more through the resistor R_4, the transistors Q_3 and Q_4 are turned OFF about 30 seconds after the discharge to stop the alarm. This operation can be realized by suitably determining the values of input resistance and capacitance of C_3. The ON-OFF action of the relay RL_2 involves a hysteresis phenomenon. Therefore the voltage across the capacitor C_3 is low at the beginning when the capacitor C_3 is charged and the relay RL_1 is actuated. Hence, to turn on the relay RL_2 whose contact has been once opened, it is necessary for the contact of RL_1 to be kept closed for several seconds additionally. In the alarm apparatus of this invention, the contact of RL_2 is kept conducting as long as a moving object by which an alarm is produced is present. In other words, an alarm continues during the presence of such moving object. To stop the alarm, the switch S_1 is closed and the charge across the capacitor C_3 is released.

In FIG. 5, the circuit B is part of the protective device. By disconnecting this circuit, the power source makes the transistors Q_3 and Q_4 conducting through the resistor R_5 and diode D_5 to effect an alarm. The lead wire comprised in the circuit B is bundled together with other lead wires extended from the antennas, key box and other parts of the main unit. Therefore, if the circuit B is opened, an alarm is delivered to indicate abnormality with the alarm apparatus itself. Furthermore, when the door of the operator panel of the main unit is opened, the microswitch S_2 is actuated to produce an alarm.

Another feature of this timing device is that the current consumed in the alarm watching state is very small. Namely, when the bases of transistors Q_1 and Q_3 stand at zero potential, the transistors Q_1, Q_2, Q_3 and Q_4 are all cut OFF, and there flows only a leakage current of about $10\mu A$.

In this timing circuit, the largest current flows in the protective circuit by way of the resistor R_5 and thence to ground; however, this current is as small as less than $100\mu A$. A dry battery may be used as the power source for this circuit. Such battery source is supposed to last more than 1 year.

Another embodiment of the invention will be described below. Referring to FIG. **6**, there is shown an alarm apparatus used as an ideal automatic monitor apparatus comprising one or several video cameras **20** through **20***n* which monitor a moving object by automatic selection within the view angles of the individual video cameras. A moving object coming in the view angles of the video cameras **20** through **20***n* is detected by the wave alarm devices **21** through **21***n*, and the monitor cathode-ray tube **22** and the video tape recorder **23** are operated by the detected signal. In the conventional industrial television and video tape recorder system, the monitor cathode-ray tube must always be monitored. When several video cameras are used, all the monitor images must be watched at all times. Whereas, according to the invention, when a moving object comes within the view angles of the video cameras **20–20***n*, the corresponding camera is connected immediately to the monitor cathode-ray tube **22** and the video tape recorder **23** whereby the monitor image is displayed on the cathode-ray tube screen and recorded on the video tape recorder **23**. For these operations no operator procedures are required.

FIG. **6** shows an arrangement wherein a video camera **20**, a monitor cathode-ray tube **22** and a video tape recorder are connected directly to each other, a wave alarm device **21** is installed within the view angle of the video camera **20**, and the signal produced in the wave alarm device **21** is supplied to the monitor cathode-ray tube **22** and video tape recorder **23**. A defense area is formed within the view angle of the video camera **20** by the wave alarm device **21**. When a moving object comes in the view angle, the alarm device **21** sends a specific signal to the monitor cathode-ray tube **22** and the video tape recorder **23** whereby the moving object is visualized and recorded.

When several video cameras **20–20***n* are used and several moving objects come into several places at the same time, the video camera **20** and vidio tape recorder **22** of the most essential place is operated according to a predetermined priority order. For example, a video signal from the video camera **20** is always displayed on the monitor cathode-ray tube **22** and, when necessary, the image on the cathode-ray tube is recorded on the video tape recorder **23**. When a moving object comes within the view angle of the video camera **20**, the alarm device **21** sends a signal to the switch device **24** installed among the video camera **20**, monitor cathode-ray tube **22** and video tape recorder **23**, thereby actuating the relay RL_1 of the switch device **24**. By this operation, the image from the video camera **20** is displayed on the cathode-ray tube **22** and, at the same time, the switch device **24** sends an operation signal to the video tape recorder **23** whereby the moving object present within the view angle of the video camera **20** is recorded on the video tape recorder **23**. Each video camera **20** has in combination one alarm device **21** and one switch device **24**. When a moving object comes within the view angle of the video camera **20**, the associated wave alarm device **21** is operated immediately and causes the video camera **20** to be directly connected to the monitor cathode-ray tube **22** and video tape recorder **23**.

We claim:

1. An alarm system utilizing electromagnetic waves for detecting a moving object, comprising, in combination:

at least one antenna means;

at least one transmitter-receiver apparatus having an oscillation loop for detecting changes in the impedance of said antenna means;

an amplifier circuit is operatively connected to said transmitter-receiver apparatus for amplifying an output signal from said transmitter-receiving apparatus;

an alarm device operatively connected to said amplifier circuit is operated by the amplified signal so that an alarm is produced in response to said object moving in the range of space covered by the electromagnetic waves rediated radiated said antenna means; and

a first timing device and a second timing device disposed between said amplifier circuit and said alarm device, said second timing device being operated when said first timing device is operated, and a charge-discharge circuit is disposed so that said second timing device stays in its operating state for a certain definite time even after said first timing device is changed over from its ON to OFF state.

2. An alarm system as defined in claim 1, wherein a plurality of said transmitter-receiver apparatus are centrally connected to said amplifier circuit, and said alarm device is operated when the antenna impedance is changed in any one of said transmitter-receiver apparatus, and thus an object moving in a wide range of space is alarmed.

3. An alarm system as defined in claim 2, including a plurality of video cameras which are operatively connected to and respectively associated with predetermined ones of said plurality of transmitter-receiver apparatus so that said object moving in the space covered by each transmitter-receiver apparatus is monitored and/or recorded by the individual monitors and/or video tape recorders operatively connected to said video cameras.

4. An alarm system as defined in claim 1, wherein said transmitter-receiver apparatus includes an oscillation circuit; a lead wire is connected into the loop of said oscillation circuit including the antenna; an oscillating current is supplied thereto through said lead wire; and said object moving in an electrostatic electric field produced around said lead wire is detected in terms of a change in the antenna impedance.

5. An alarm system as defined in claim 1, including a video camera operable in response to changes in the antenna impedance of said transmitter-receiver apparatus, and a monitor and/or a video tape recorder connected to said video camera, and said object moving in the space of said electromagnetic waves is displayed on said monitor and/or recorded on said video tape recorder.

6. An alarm system as defined in claim 1, including a bandpass filer disposed in said amplifier circuit for removing high frequency components such as hum noise.

7. An alarm system utilizing electromagnetic waves for detecting a moving object, comprising, in combination:

at least one antenna means;

at least one transmitter-receiver apparatus having an oscillation loop for detecting changes in the impedance of said antenna means;

an amplifier circuit is operatively connected to said transmitter-receiver apparatus for amplifying an output signal from said transmitter-receiver apparatus;

an alarm device operatively connected to said amplifier circuit is operated by the amplified signal so that an alarm is produced in response to said object moving in the range of space covered by the electromagnetic waves radiated from said antenna means;

a timing device disposed between said amplifier circuit and said alarm device;

said alarm device is operated only when the intensity and the timing of the received signal and said transmitter-receiver apparatus exceeds their specific predetermined values; and

wherein said timing device includes: a transistor, a diode connected between the base of said transistor and the power source, and a lead wire connected between said power source and the ground so that the current to flow in the base of said transistor is normally cut off; and said timing device is operated in such a manner that current is supplied to said base via said diode by disconnecting said lead wire, and thus the alarm circuit connected to the output side of said transistor is operated.

* * * * *